Nano-Biosystems

Opportunity

A cell is a micrometer-sized factory with molecular machinery operating on the nanometer scale. Thus, a fundamental understanding of nano-biostructures and processes will open broad opportunities in nano-biotechnology, nano-medicine, and biomaterials.

Priorities

Priority areas include developing an understanding of the relationships among composition, structure, single molecule behavior, and biological function. Additional research areas include the study of organelles and subcellular complexes such as ribosomes and molecular motors; construction of nanometer-scale probes and devices for research in genomics, proteomics, cell biology, and nanostructured tissues; and synthesis of nanoscale materials based on the principles of biological self-assembly.

Research Example: Nature's Tools to Assemble Materials with Atomic Precision (supported by NSF)

Among the basic assembly processes nature uses are nanoscale self-assembly, molecular recognition, self-correction, and nano-structural regularity. Researchers at the University of Texas at Austin have developed new assembly techniques, based on biomolecular recognition. Using this technique, amino acids, such as those in simple peptides or on the surfaces of viruses, are designed to recognize and bind to specific nonbiological electronic and magnetic materials. Complex structures can be assembled by tailoring the biomolecules appropriately, as shown in Figure 4. One advantage is that such processes take place at near-ambient conditions. In the future, biologically inspired assembly may provide cost-effective alternative manufacturing processes.

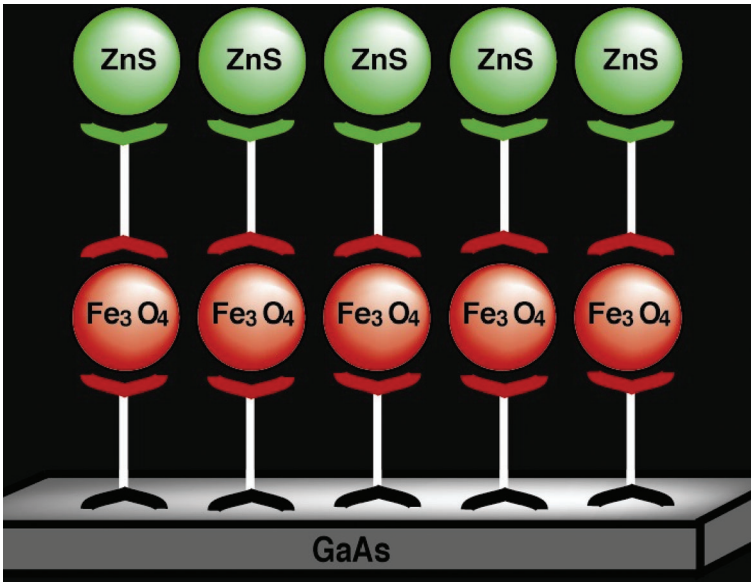

Figure 4. Illustration of how biomolecular recognition processes may be used to assemble a magneto-electronic structure composed of zinc sulfide (ZnS) and iron oxide (Fe_3O_4) nanoparticles. Two tailored bifunctional peptides, one that binds the gallium arsenide substrate to iron oxide, and the other that binds the iron oxide particle to zinc sulfide, control the formation of the layered structure. Such directed self-assembly processes have the potential to replace far more complex processes used in conventional micro- and nano-electronic manufacturing (courtesy A.E. Belcher, now at Massachusetts Institute of Technology).